REUSE OF SOFTWARE ASSETS FOR THE NASA EARTH SCIENCE DECADAL SURVEY MISSIONS

Chris A. Mattmann[1,4], Robert R. Downs[2], James J. Marshall[3], Neal F. Most[3], Shahin Samadi[3]

[1]Jet Propulsion Laboratory
California Institute of Technology
Pasadena, CA 91109, USA
mattmann@jpl.nasa.gov

[2]Center for International Earth Science Information Network
Columbia University
Palisades, NY 10964, USA
rdowns@ciesin.columbia.edu

[3]INNOVIM
NASA Goddard Space Flight Center
Mail Stop 614.9
Greenbelt, MD 20771, USA
James.J.Marshall@nasa.gov
Neal.F.Most@nasa.gov
Shahin.Samadi-1@nasa.gov

[4]Computer Science Department
University of Southern California
Los Angeles, CA 90089, USA
mattmann@usc.edu

1. ABSTRACT

The future Earth science missions at the National Aeronautics and Space Administration (NASA) promise to provide an explosion of data and a platform for science that previously was unachievable using existing hardware, software, and assets. Instrument resolution is increasing, as is the ability of software and hardware to deal with data volumes that will easily grow to the 10–100 petabyte range in the next five years. Over the past twenty years, NASA has invested in software to support all phases of the Earth science mission pipeline. These investments include components and architectures that support science data processing (once data has been downlinked to a ground station) and data archival and dissemination at the Distributed Active Archive Centers (DAACs), as well as ad-hoc data analyses and custom product generation using DAAC-provided data.

However, many of the aforementioned components and architectural patterns are reconstructed for each mission. There are a number of reasons for this including: (1) the distributed scientific expertise of NASA, and (2) the desire to have that expertise co-located with the data as it is processed and delivered

for wide dissemination. With the changing paradigm of NASA missions[1], it is even more imperative that NASA look to reduce costs, increase software productivity, and ultimately reuse successful software assets and patterns across the mission efforts. Software reuse can help inform the successful design of future NASA missions in a number of different ways, in particular through: (1) identification and selection of existing, proven Earth science software components (or software components applicable in Earth science data systems) whose reuse saves development costs and time; (2) application of existing architectural styles and patterns [1] that induce specific quality attributes (reliability, scalability, etc.) in the resultant software; and (3) identification of new assets developed for missions which are of broader applicability, and themselves should be disseminated to the community, to name a few. Reusable software artifacts are not limited to just code either: assets also may include algorithms, architectures, and documentation, as well as other artifacts produced during the software development life cycle.

The NASA Earth Science Data Systems (ESDS) Software Reuse Working Group [2] is chartered with the promotion and identification of software assets targeted for reuse in NASA's Earth Science Data System pipeline. The group is focused on cutting edge architectures and technologies that facilitate software reuse. In particular, we are currently investigating software components and architectures developed to enable cloud and grid computing capabilities, as well as cyberinfrastructure for using mission and scientific data. The shining product of the group to date is a focused set of NASA Reuse Readiness Levels (RRLs). RRLs, similar to the NASA Technology Readiness Levels (TRLs) for technology, are a nine-level guide, helping to rank and compute the reusability of a software asset [3].

2. ACKNOWLEDGEMENTS

The authors are grateful to the members of the National Aeronautics and Space Administration (NASA) Earth Science Data Systems Software Reuse Working Group who have contributed to the efforts described in this work. Support was provided for Robert Downs under NASA contract NAS5-03117. This effort was supported in part by the Jet Propulsion Laboratory, managed by the California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

3. REFERENCES

[1] R. N. Taylor, N. Medvidovic, and E. M. Dashofy, "Software Architecture: Foundations, Theory, and Practice," John Wiley & Sons, 2009. In press.

[2] J. J. Marshall, R. R. Downs, S. Samadi, N. S. Gerard, and R. E. Wolfe, "Software reuse to support earth science", *Journal of Frontiers of Computer Science and Technology*, 2(3): 296-310. Online: http://www.ceaj.org/wes/qikan/manage/wenzhang/T0804026.pdf

[3] J. J. Marshall and R. R. Downs, "Reuse Readiness Levels as a Measure of Software Reusability", *Geoscience and Remote Sensing Symposium, 2008. IGARSS 2008. IEEE International*, vol. 3, pp. III-1414–III-1417, 7–11 July 2008. doi: 10.1109/IGARSS.2008.4779626

[1] Primarily induced by the upcoming missions identified in the National Research Council's Earth Science and Applications from Space decadal survey (as well as other future "decadal-like" missions).